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(71) Applicant: Tohoku Munekata Co., Ltd.

(72) Inventors: Hiroyuki TATEYAMA, et al.

(74) Agent: Patent Attorney, Hiroshi OOHASHI

(54) [Title of the Invention] MANUFACTURING METHOD OF
INJECTION-MOLDED PLASTIC PRODUCT NOT PRODUCING SINK
MARK ON VISIBLE SURFACE THEREOF AND APPARATUS THEREFOR

(59) [Abstract]

[Object] To achieve a manufacturing method of an injection-molded plastic product not producing a sink mark on the visible surface thereof, and an apparatus therefor.

[Construction] Heating means is attached in the proximity of a concave portion 4 of the mold (cavity 3) on the side producing a sink mark, and the surface of concave portion 4 of the cavity 3 is heated to a temperature over the glass transition temperature of the resin by holding the same at this temperature by this heating means during molding.

[Claims]

[Claim 1] A manufacturing method of an injection-molded plastic product not producing a sink mark on a visible surface, comprising the steps, during injection molding of a plastic product suffering from occurrence of a sink mark, of controlling sink-occurring portion onto the invisible side by heating the surface of a concave portion of the mold on the product visible surface side producing the sink mark and holding the same at this temperature.

[Claim 2] The manufacturing method of an injection-molded plastic product not producing a sink mark on a visible surface according to claim 1, wherein the surface of the mold cavity on the visible surface side producing the sink mark is heated to a temperature over a glass transition temperature of the resin and held at this temperature.

[Claim 3] The manufacturing method of an injection-molded plastic product not producing a sink mark on a visible surface according to claim 1 or 2, wherein the surface of the mold cavity on the visible surface side producing the sink mark is heated to a high temperature and held at this temperature, and at the same time, the cavity surface of the mold on the side not producing the sink mark is cooled.

[Claim 4] A manufacturing method of an injection-molded plastic product, comprising the step of forming a heating section near a mold cavity in a mold of a visible surface of

the product producing a sink mark so as to permit heating and holding of the cavity surface of the mold on the product visible surface side by means of said heating section.

[Claim 5] The manufacturing apparatus of an injection-molded plastic product according to claim 4, comprising an electric heater incorporated in a mold on a visible surface side of a product producing the sink mark so as to permit heating and holding of the mold cavity surface.

[Claim 6] The manufacturing apparatus of an injection-molded plastic product according to claim 4, wherein a heat medium circulation channel is formed in the mold on the visible surface side of the product producing the sink mark so that a high-temperature heat medium is circulated in said heat medium circulation channel to permit heating and holding of the cavity surface in the mold on the visible surface side of the product.

[Claim 7] The manufacturing apparatus of an injection-molded plastic product according to claim 4, wherein a Peltier element is incorporated in the mold on the visible surface side of the product producing a sink mark to heat and cool the cavity surface and to permit cooling.

[Claim 8] The manufacturing apparatus of an injection-molded plastic product according to claim 4, wherein a chemical-reaction heating/combustion unit is incorporated in the mold on the visible surface side of the product

producing the sink mark to heat and hold the cavity surface.

[Claim 9] The manufacturing apparatus of an injection-molded plastic product according to claim 4, wherein a heating unit based on high frequency wave, microwave or ultrasonic wave is incorporated in the mold on the visible surface side of the product producing the sink mark to permit heating and holding of the mold cavity surface of the product visible surface.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to a manufacturing method and an apparatus (mold) therefor of an injection-molded plastic product not producing a sink mark on the visible surface through control of the sink-mark occurring position by heating to a high temperature and holding at this temperature, or cooling to a low temperature and holding at this temperature the mold surface for a specific period of time during a process from injection molding to cooling, using a thermoplastic resin as a material.

[0002]

[Description of the Related Art] When injection-molding a plastic product having a boss, a rib or a deviated-thickness portion, a sink mark occurs on the surface of a portion having a largely different thickness of the product. A

cause of the sink mark is that the molten thermoplastic resin shrinks upon cooling and resultant solidification in the mold, cooling being slower at a portion thicker than the surrounding portions, and this thicker portion solidifies accompanying shrinkage after solidification of the surroundings. Particularly, the cavity side usually serving as a product visible surface of a plastic product is flat and easy to cool as compared with the core side having a complicated structure such as a boss or a rib, resulting in earlier mold releasing than the core side and then shrinkage, thus tending to suffer from occurrence of a sink mark.

[0003] A sink mark is a concave dent of a product surface. It impairs the look of the product, leading to a decreased value of the product, and causes another problem in that it spoils the beauty of the product by hindering uniform coating, resulting in a higher cost for repairing.

[0004] Known measures against occurrence of a sink mark include a method of achieving uniform cooling by providing a thinner portion surrounding the thick portion of the product, a method of supplying the shrinkage, and a method of heating or cooling the mold within a range with temperature-adjusting water.

[0005]

[Problems to be Solved by the Invention] However, the above-mentioned conventional methods have problems in that

the necessity to fabricate the portion surrounding the boss hole on the core side leads to a complicated product shape, and hence to difficulty to cope with, or even when supplying the shrinkage, a sufficient effect of supply cannot be expected for some shapes of the product.

[0006] The method of heating or cooling cannot always provide a sufficient effect since the applicable temperature range is limited when using temperature-adjusting water.

[0007] The present invention was developed in view of the above-mentioned circumstances, and has an object to provide a method and an apparatus for manufacturing an injection-molded plastic product which permit control of occurrence of a sink mark on the product visible surface, irrespective of the product shape.

[0008]

[Means for Solving the Problems] The method and the apparatus for manufacturing an injection-molded plastic product of the present invention have the following configuration.

[0009] 1. A manufacturing method of an injection-molded plastic product not producing a sink mark on a visible surface, comprising the steps, during injection molding of a plastic product suffering from occurrence of a sink mark, of controlling sink-occurring portion onto the invisible side by heating the surface of a concave portion of the mold on

the product visible surface side producing the sink mark and holding the same at this temperature.

[0010] The heating temperature of the mold cavity surface of the visible surface of the product producing the sink mark must be equal to or higher than the glass transition temperature of the resin.

[0011] 2. A manufacturing method of an injection-molded plastic product, comprising the step of forming a heating section near a mold cavity in a mold of a visible surface of the product producing a sink mark so as to permit heating and holding of the cavity surface of the mold on the product visible surface side by means of said heating section.

[0012] Applicable methods for heating or cooling the mold include a method of using usual water as a medium and the mold as a heat exchanger, and controlling the water temperature outside the apparatus, a method of using oil as a medium to achieve specifications for a higher temperature, a method based on an electric resistance of the Joule heat heating type, a method based on Peltier element permitting both cooling and heating, a molecular heat friction heating method using a high frequency wave, microwave or ultrasonic wave, a chemical-reaction heating/combustion method, and methods based on a combination thereof.

[0013] Resins applicable in the present invention include not only general-use resins such as polyolefin resin,

polystyrene resin and ABS resin, and industrial resins such as polycarbonate resin, and polyamide resin, but also various resin mixtures and those mixed with a reinforcing agent. There is no particular restriction in this respect.

[0014]

[Operation] When heating the mold on the visible surface side of a product producing a sink mark to a high temperature and holding the same at this temperature, as described above, a decrease in temperature caused when a resin heated to about 200°C is charged in the lower-temperature mold is alleviated, and a decrease in fluidity is also reduced. Surface irregularities are thus more fully filled. As a result, portions in contact between the mold surface irregularities and the resin are larger than in the case without heating, heating to harder mold releasing. Since the mold temperature is kept at a high level even during cooling after injection of the resin into the mold, the decrease in resin temperature is slower, and shrinkage is slow. It is therefore more difficult to release the mold than the resin surface in contact with the non-heated side of the mold. This results in earlier mold releasing of the non-heated side resin surface, and the subsequent shrinkage causes occurrence of a sink mark. Occurrence of the sink mark is therefore inhibited and controlled on the resin surface on the heated cavity side.

[0015] In the above-mentioned case of high-temperature heating, cooling of the core side is more effective.

[0016]

[Embodiments] An embodiment of the present invention will now be described with reference to Figs. 1 and 2. Fig. 1 is a schematic sectional view of an injection molding mold.

[0017] The injection molding mold 1 shown in Fig. 1 roughly comprises a core 2 on the product invisible surface side and a cavity 3 on the product visible surface side. Both the core 2 and the cavity 3 are connected to an injection molding machine outside Fig. 1 and can be opened/closed. A concave portion 4 corresponding to the exterior shape of an injection-molded product a in the core 2 and the cavity 3. Molten plastics is poured into the concave portion 4 from the injection molding machine not shown in a spool 5 provided at a prescribed position in the cavity 3 to form a plastic molded product a. The resultant plastic molded product a has a boss b and a rib c.

[0018] A plurality of temperature adjusting pipe 6 for the flow of a temperature adjusting fluid, which pass through the cavity 3, are provided near the concave portion 4, corresponding to the exterior shape of the injection-molded product a, and connected to a temperature adjusting apparatus having a heater and a cooler not shown. While the molten plastics from the injection molding machine not shown

is poured into the concave portion 4 and cooled to form a plastic molded product a, mainly the surface on the visible portion e side of the plastic molded product of the cavity 3 is heated and cooled. The aforementioned embodiment will now be described further in detail.

[0019] A sheet-shaped product having a product size of 150 x 200 mm, a thickness of 2.5 mm, provided with a boss having an outside diameter of 15 mm, an inside diameter of 6 mm and a height of 10 mm, and a rib having a thickness of 6 mm and a height of 20 mm on the back was formed, with a cross-sectional structure as shown in Fig. 2, by using the apparatus shown in Fig. 1 and polystyrene (HH501, made by Showa Denko K.K.).

[0020] Upon molding, the cavity mold surface of the product visible surface was heated to a temperature of 100°C or higher which was over the glass transition temperature of the resin used and held at this temperature for a period of time longer than 60 seconds during the injection and cooling processes of the resin.

[0021] On the resultant plastic molded product visible surface, there was no occurrence of a sink mark on the visible surface e side as shown in Fig. 2, and sink marks f occurred at the base of the boss b and the rib c on the product invisible surface.

[0022] As a comparative example, a product was formed under

the same conditions as in the above-mentioned example except that the heating temperature in the above-mentioned example was changed to 90°C which was lower than the glass transition temperature of the resin. As shown in Fig. 3, in the resultant product, a sink mark occurred on the side opposite to that in the example, i.e., on the visible surface of the plastic molded product, and no sink mark was observed on the product invisible surface.

[0023]

[Advantages] According to the present invention, as described above, a sink mark is selectively caused on the invisible surface side by heating the mold surface on the visible surface side of the plastic product during forming. It is possible to control the sink-occurring position so as to prevent occurrence of a sink mark on the visible side. As a result, there is provided a remarkable merit in beauty and accuracy of the plastic molded product, and a considerable advantage is obtained in the reduction of rejectable products.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 is a sectional view illustrating typical injection molding method and mold in an embodiment of the present invention.

[Fig. 2] Fig. 2 is a descriptive view illustrating a sink mark occurring on the surface of a plastic molded product

formed by the injection molding method and the mold in an embodiment of the present invention.

[Fig. 3] Fig. 3 is a descriptive view illustrating a sink mark occurring on the surface of a plastic molded product formed by the conventional injection molding method and mold.

[Reference Numerals]

- 1: Mold
- 2: Core
- 3: Cavity
- 4: Concave portion
- 5: Sprue
- 6: Temperature-adjusting pipe
- a: Plastic molded product
- b: Boss
- c: Rib
- d: Plastic molded product invisible surface
- e: Plastic molded product visible surface
- f: Position of sink mark



FIG. 1

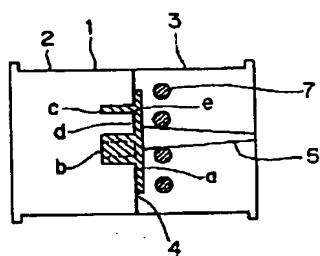


FIG. 2

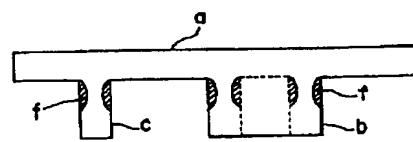


FIG. 3

